

**TECHNICAL DRAFT**  
**RECOVERY PLAN**  
**FOR THE**  
**ARMORED SNAIL**



TECHNICAL DRAFT RECOVERY PLAN  
for the  
*Armored Snail (Pyrgulopsis pachyta)*

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Recovery plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

**Literature citations should read as follows:**

U.S. Fish and Wildlife Service. 1994. Technical Draft Armored Snail Recovery Plan. Atlanta, GA. 25 pp.

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## EXECUTIVE SUMMARY

Current Status: The armored snail is known only from Piney and Limestone Creeks in Limestone County, Alabama. Armored snails are generally found among submerged tree roots and bryophytes along the stream margin, in areas of slow to moderate flow. Occasionally they are found in the submerged detritus along pool edges. This Alabama endemic is proposed as endangered. No critical habitat has been designated for this species.

Habitat Requirements and Limiting Factors: Potential degradation of the water quality of the two streams is the most significant threat to the species' continued survival. Because the armored snail has a 1-year life cycle, it is subject to sudden extinction should its habitat deteriorate, even for a short term, to the point where a single year's reproduction fails or is significantly reduced. Human-related activities that could prove detrimental to the water quality of the streams (by causing/increasing siltation and nutrient or pollutant loading or by altering water levels, temperature, or pH) include, but are not limited to, increased development, indiscriminate logging and other land use changes, stream alteration (such as channelization or impoundment), withdrawal of water, road and bridge construction, runoff of pesticides and fertilizers, leachate from septic systems and mines, and other point and nonpoint pollution discharge.

The introduction/invasion of nonnative species into either stream inhabited by the armored snail poses another serious threat. Invasion/introduction of nonnative aquatic weeds into the streams could eventually result in the elimination of the habitat required by the armored snail and require intensive and potentially harmful control measures. Another major concern is the zebra mussel (*Dreissena polymorpha*). There is concern that the tremendous filtering activity exerted by high-density populations of the species could disrupt the natural food chain and affect entire aquatic communities in infested lakes and streams.

Recovery Objective: Maintain self-sustaining populations of the armored snail in both of the streams they are presently known to inhabit and protect their habitat from present and foreseeable threats. Based on available information concerning the range, biology, and threats to its continued survival, delisting of the armored snail does not appear to be feasible.

Recovery Criteria: The species' biology and restricted distribution make it unlikely that the armored snail can be sufficiently protected from all threats associated with potential degradation and alteration of the water and/or habitat quality of the streams they inhabit. Therefore, delisting is unlikely. However, as additional data on the species and threats to its continued existence are obtained, the potential for developing recovery criteria will be reevaluated.

Actions Needed:

1. Protect the existing population and essential habitat.
2. Determine threats to the species, conduct research necessary for the species' management, and implement management where needed.
3. Develop artificial holding and propagation techniques and, if feasible, establish captive populations.
4. Develop and implement cryogenic techniques to preserve the species' genetic material.
5. Develop and implement a program to monitor armored snail population levels and water/habitat conditions of each of the streams.
6. Annually assess the overall success of the recovery program and recommend action (changes in recovery objectives, continue to protect, implement new measures, other studies, etc.).

Cost (\$000's):

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6	Total
1994	2.0	10.0	10.0	5.0	2.5	1.5	31.0
1995	2.0	10.0	10.0	5.0	2.5	1.5	31.0
1996	2.0	10.0	2.0	5.0	2.5	1.5	23.0
1997	2.0	5.0	2.0	2.0	2.5	1.5	15.0
1998	2.0	?	2.0	2.0	2.5	1.5	10.0*
1999	2.0	?	2.0	2.0	2.5	1.5	10.0*
2000	2.0	?	2.0	2.0	2.5	1.5	10.0*
2001	2.0	?	2.0	2.0	2.5	1.5	10.0*
2002	2.0	?	2.0	2.0	2.5	1.5	10.0*
2003	2.0	?	2.0	2.0	2.5	1.5	10.0*
2004	2.0	?	2.0	2.0	2.5	1.5	10.0*
TOTAL	22.0	35.0*	38.0	31.0	27.5	16.5	170.0*

\*Habitat improvement costs needed for the species' management will not be known until the magnitude of specific threats is determined through research.

Date of Recovery: Total recovery is unlikely for this species.



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PART I  
INTRODUCTION

On (Insert Listing Date Here), 1994 (Insert FR Here), the U.S. Fish and Wildlife Service (Service) proposed to list the armored snail (*Pyrgulopsis pachyta*) as an endangered species (Service 1994). Critical habitat was not designated. This species has been recorded only from Piney and Limestone Creeks in Limestone County, northeastern Alabama. Its continued existence is dependent upon maintaining the water and habitat quality of these two sites.

Description, Ecology, and Life History

The armored snail (*Marstonia pachyta*) was described by Thompson in 1977 and was later reassigned to the genus *Pyrgulopsis* by Hershler and Thompson (1987). The armored snail is a small (usually less than 4 millimeters [0.16 inch] in length), presumably annual, species. It is distinguished from other closely related species by the characteristics of both its verge and shell. The armored snail has a small raised gland on the ventral surface of the verge (a trait common only with the beaverpond snail [*P. castor*] of this genus) and two small glands along the left margin of the apical lobe. The apical lobe is smaller than in most species of *Pyrgulopsis* (Thompson 1977). Garner (1993) noted some variation in verge characters (more developed apical lobes) but attributed differences to temporal changes in verge morphology throughout the annual life cycle. The shell is easily identified by its ovate-conical shape, its pronounced thickness, and its complete peristome. Other *Pyrgulopsis* species

with ovate-conical shells have much thinner, almost transparent, shells, and the peristome is seldom complete across the parietal margin of the aperture (Thompson 1977).

The armored snail is known only from Piney and Limestone Creeks in Limestone County, Alabama. Armored snails are generally found among submerged tree roots and bryophytes along the stream margin, in areas of slow to moderate flow. Occasionally they are found in the submerged detritus along pool edges.

No populations of the armored snail are known to have been lost (Wheeler Lake may have separated what was once one larger population into the present two populations). However, the general deterioration of water quality resulting from siltation and other pollutants contributed by poor land use practices are impacting the species and could become a serious, irreversible threat.

Additionally, because both existing populations inhabit extremely limited areas, they are very vulnerable to extirpation from accidental toxic chemical spills or vandalism. Further, because these populations are isolated, their long-term genetic viability is questionable, and recolonization of an extirpated population would be unlikely without human intervention.

### Distribution and Threats to Its Continued Existence

The armored snail is found in only two streams in Limestone County, Alabama. The species has never been taken from outside these two areas.

Potential degradation of the water quality of the two streams inhabited by the armored snail is the most significant threat to the species' continued survival. Because the armored snail has a 1-year life cycle, it is subject to sudden extinction should its habitat deteriorate, even for a short term, to the point where a single year's reproduction fails or is significantly reduced. Human-related activities that could prove detrimental to the water quality of the streams (by causing/increasing siltation and nutrient or pollutant loading or by altering water levels, temperature, or pH) include, but are not limited to, increased development, indiscriminate logging and other land use changes, stream alteration (such as channelization or impoundment), withdrawal of water, road and bridge construction, runoff of pesticides and fertilizers, and leachate from septic systems and mines, and other point and nonpoint pollution discharge.

The introduction/invasion of nonnative species into either stream inhabited by the armored snail poses another serious threat.

Invasion/introduction of nonnative aquatic weeds (e.g., *Hydrilla*) into the streams could eventually result in the elimination of the habitat required by the armored snail and require intensive and

potentially harmful control measures. Another major concern is the zebra mussel (*Dreissena polymorpha*). This exotic freshwater mussel was first discovered in Lake St. Clair in the mid- to late 1980s. It has since colonized all five of the Great Lakes and is rapidly expanding into the surrounding river basins (O'Neill and MacNeill 1991). Many biologists believe this species may ultimately infest most areas of North America. *Dreissena polymorpha* is a prolific breeder and, once established in an area, can reach very high density levels (O'Neill and MacNeill 1991). There is concern that the tremendous filtering activity exerted by high-density populations of the species could disrupt the natural food chain and affect entire aquatic communities in infested lakes and streams (Hebert et al. 1991, O'Neill and MacNeill 1991, Weigmann et al. 1991).

PART II  
RECOVERY

A. Recovery Objective

The Service's goal in developing and implementing recovery plans is to recover a species to the point where protection under the Endangered Species Act of 1973, as amended (Act), is no longer required. This is often accomplished through the establishment and protection of some specified number of self-sustaining populations throughout a significant portion of the species' historic range. A self-sustaining population is a reproducing population that is large enough to maintain sufficient genetic variation to enable it to survive and respond to natural habitat changes without intensive management. These populations must be sufficiently dispersed, or occur on large enough tracts, to ensure their perpetuation. However, based on available information concerning the range, biology, and threats to its continued survival, recovery of the armored snail does not appear to be likely (unless other populations are discovered or other populations are established in some presently unknown historic habitat). It is doubtful that the armored snail can be sufficiently protected from all threats associated with potential degradation/alteration of the water and/or habitat quality of the streams it inhabits. Therefore, delisting is unlikely. However, as additional data on the species and threats to its continued existence are obtained, the potential for developing recovery criteria will be reevaluated.

Accordingly, the objective of this recovery plan is to protect and maintain self-sustaining populations of the armored snail in the two known sites and to protect its habitat from present and foreseeable threats.



## B. Narrative Outline

1. Protect existing populations and essential habitat. The armored snail occurs in only two streams in Limestone County, Alabama. Although there are many other streams in the lower bend of the Tennessee River, the armored snail has never been found outside its present range. Because the species has a 1-year life cycle, it depends upon successful reproduction each year for its survival. Any activity, incident, etc., adversely affecting water or habitat quality of the streams, even for brief periods during a given year, could result in the extinction of the armored snail. All actions and activities around the streams and their watersheds must be carefully reviewed, planned, and implemented with the protection of the armored snail in mind. Lack of proper protection and management of these populations and the streams they inhabit will ultimately lead to the species' extinction.

- 1.1 Utilize existing legislation and regulations (the Act, Federal and State water quality regulations, stream alteration regulations, surface mining laws, etc.) to protect the species and its habitat. Degradation of the water quality of the streams appears to be the most significant threat to the survival of the armored snail. Complete compliance with Federal and State laws

and regulations designed to protect water and habitat quality must be ensured if the species is to survive. Unless this objective is met, any other recovery activities would be futile.

- 1.2 Work with appropriate Federal and State regulatory and review agencies to identify and assess projects and/or activities that could have negative effects on the species and to ensure incorporation of measures for protecting the species and its habitat into such activities. Through Section 7 of the Act, the Fish and Wildlife Coordination Act, Clean Water Act, etc., Federal and State regulatory and review agencies must work together to carefully evaluate and identify actions and activities that have the potential to adversely affect the species and/or its habitat. Once impacts have been identified, regulatory/permitting agencies must utilize their authority to ensure that the species and its habitat are adequately protected.
- 1.3 Solicit help in protecting and enhancing the species and its essential habitat. The assistance and support of conservation groups, local governments, and regional and local planners will be essential in meeting the goal of maintaining the armored snail. Also, the support of local industrial, business, and farming

communities, as well as local residents, is vital. Construction, forestry, and agricultural "best management practices" must be implemented by all landowners. Local and county land use planning must be designed and implemented to protect the armored snail and its watersheds. Individuals should be educated regarding the natural processes of the streams, how human activities influence these processes, and measures needed to protect the streams and the armored snail. Without a continuing commitment from the local people who have an influence on the water and habitat quality of the streams, any efforts to maintain the armored snail will meet with little success.

- 1.3.1 Meet with local government officials and regional and local planners to inform them and solicit their support for protection of the species and its essential habitat.
- 1.3.2 Meet with local business, farming, logging, and industry interests and elicit their support and, where feasible, provide them assistance in implementing protective actions.
- 1.3.3 Develop an educational program using such items as slide/tape shows, brochures, etc. Present

this material to business groups, civic groups, schools, church organizations, etc.

Educational material outlining the goals and emphasizing the benefits of maintaining and upgrading habitat quality will be extremely useful in informing the public of our actions and implementing Tasks 1.3.1 and 1.3.2.

1.4 Encourage the establishment of high-quality water designations, buffer zones, conservation easements, and other protection strategies as a means of protecting the species. The Service should work with the appropriate State agencies in Alabama to have special status assigned to the streams and their watersheds that would provide increased protection to the armored snail.

2. Determine threats to the species, conduct research necessary for the species' management, and implement management where needed.

2.1 Conduct research on the species and characterize the specific habitat requirements (relevant physical, biological, and chemical components) for all life history stages. Detailed knowledge of the habitat requirements of the species; community structures of

associated flora and fauna; and how these biotic and abiotic factors interact and affect reproduction, growth, and mortality rates of the armored snail are needed in order to focus management and recovery efforts on specific problems within the species' habitat. Knowledge of the environmental requirements of all life history stages of the species and an understanding of the nature of the habitat occupied by the species is essential in order to manage for the species' long-term survival.

2.2 Identify and eliminate current and future threats to the species' survival. Water/habitat quality deterioration/alteration (by increasing siltation and nutrient or pollutant loading or by altering water retention time, temperature, or pH) and the introduction/invasion of nonnative species appear to be the primary threats to the armored snail. Potential sources of these threats (and other potential threats) need to be identified and methods and effects of controlling/altering these sources need to be determined. The nature of and mechanisms by which these and other factors impact the species are not entirely understood. The extent to which the species can withstand these impacts is also unknown. To minimize and eliminate these threats, the information

gathered in Task 2.1 must be utilized to target and correct specific problem areas and determine the specific causative agent(s).

2.3 Based on the biological data and threat analysis, investigate the need for management, including habitat improvement. Implement management where needed to secure the species. Specific components of the armored snail's habitat may be stressed or threatened, and this may limit the species' potential for survival. Habitat improvement programs may be needed to alleviate these threats to the species.

2.4 Determine the number of individuals required to maintain a viable population. Many species are well adapted to inbreeding, including many mollusks (Selander 1983), though their evolutionary longevity may be limited. In general, however, inbreeding depression can be a major obstacle to species recovery, especially if the remaining population sizes are small and/or have gone through some type of genetic bottleneck. The actual number of individuals in a population is not necessarily a good indication of a population's genetic viability; rather, the "effective population" size is needed. The effective population size is the size of an "ideal" population in which

genetic drift takes place at the same rate as in the actual population (Chambers 1983). Franklin (1980) suggested that the inbreeding coefficient (the probability that two alleles present at a locus are identical by descent) should be limited to no more than 1 percent per generation, a figure that implies that the short-term, maintenance effective-population-size should be no fewer than 50 individuals (Frankel and Soulé 1981, Franklin 1980, Soulé 1980). Because the effective population size is typically only one-third to one-fourth the actual population size (being affected by sex ratio, overlapping generations, generally nonrandom distribution of offspring, and nonrandom mating) (Soulé 1980), a population of 150 to 200 individuals is needed for short-term population maintenance. Soulé (1980) further suggests that for long-term viability, an effective population of 500 individuals is necessary, translating into a population size of 1,500 to 2,000 individuals. The mating system of this species needs to be determined as well as a measure of population heterozygosity to determine if inbreeding is in fact a problem. Some of these factors can be addressed under Task 2.1, while others will need to be addressed as part of this task.

3. Develop artificial holding and propagation techniques and, if feasible, establish captive populations. There is an immediate need to develop techniques for holding and propagating the armored snail to allow for the reestablishment or augmentation of existing populations. Under present conditions, with the species occurring in only two streams, it would be easy to lose one or both populations. This, coupled with the species' biology, makes the armored snail extremely vulnerable to extinction from a single catastrophic event or a combination of events/activities adversely affecting the two streams, even for a short period of the year. Because the species is found in only two streams, reintroduction into other areas may not be appropriate or feasible. The development of artificial holding/propagation techniques and, if feasible, the establishment of captive populations would allow for (1) the reestablishment of a population in the streams, if either or both of the populations were lost, or (2) population augmentation, if the present populations were significantly reduced in number to a point where their viability and survival were threatened. The number of individuals necessary to maintain viability will be determined in Task 2.4.
4. Develop and implement cryogenic techniques to preserve the species' genetic material. No attempts have been made to



transport and hold armored snails or to develop artificial propagation techniques (Task 3 above). This may take a substantial period of time. Also, because of the species' biology, long-term maintenance of captive populations may not be feasible. Cryogenic preservation of the armored snail could indefinitely maintain genetic material from the extant populations (much like seed banks for endangered plants). Once artificial holding/propagation techniques are developed, cryopreservation could then allow for the eventual creation and reestablishment of armored snail populations (if necessary), using genetic material preserved from that population without requiring the continuous maintenance of a captive population.

5. Develop and implement a program to monitor armored snail population levels and water/habitat conditions of each of the streams. The status of the species and its habitat must be continually monitored in order to assess its condition and identify any potential problems. Quantitative samples should be taken to determine armored snail population densities and the chemical, physical, and biological quality of each of the streams. This monitoring should be conducted at least on a biannual schedule.
6. Annually assess overall success of the recovery program and recommend action (change the recovery objective, continue to

protect, implement new measures, conduct other studies,  
etc.). The recovery plan must be evaluated periodically to  
determine if it is on track and to recommend future actions.  
As more is learned about the species and as conditions  
change, the recovery objective may need to be modified.

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Extension, Publication 420-900. 5 pp.

## PART III

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The following agencies, organizations, and individuals were mailed copies of this recovery plan. This does not imply that they provided comments or endorsed the contents of this plan.

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